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Research Article

# Single Visit Root Canal Treatment: Intensity of Postoperative Pain Using AH Plus Sealer Versus Endosequence BC Sealer in Patients with Asymptomatic Apical Periodontitis (A Randomized Clinical Trial)

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## Abstract

**Introduction:** Pain is unwanted but common sensation after root canal treatment. Studies have shown that endodontic postoperative pain between 3 to 58%. Pain may occur in periodontal tissues after mechanical, chemical and microbial injuries. There are various parameters in treatment that can cause postoperative pain. one of these parameters is including working length. Also, the number of visits, selection of instruments and the selection of root canal sealers.

**Aim of the Study:** To compare the potential effects of resin-based and bioceramic sealers on the occurrence and intensity of postoperative pain in patients with asymptomatic apical periodontitis.

**Methods:** Sixty eight patients with asymptomatic apical periodontitis multirooted teeth were included. After confirming the diagnosis clinically and radiographically, patients were randomly assigned into two equal groups of 34 patients each. Standard endodontic treatment was performed in single visit. During the obturation the patients in the intervention group were treated using Endosequence BC sealer; while AH Plus sealer was used during obturation in patients assigned to the comparator group.

Assessment was done 6, 12, 24, 48, 72 hours and 5 days postoperatively. Visual Analogue Scale (VAS) was used in the outcome measurement. Contact with the patients was done over the phone at each follow up time as a reminder for the patients and an appointment was scheduled to receive the chart. Then data was statistically analyzed.

**Results:** Results showed that there was no statistically significant difference between the two sealers groups: AH Plus sealers and Endosequence BC sealer regarding intensity of postoperative pain at 6 hours, 12 hours, 24 hours, 48 hours, 72 hours and 5 days.

**Conclusion:** Post endodontic pain in the teeth diagnosed with asymptomatic apical periodontitis (AAP) and obturated with resin based or bioceramic root canal sealers without extrusion beyond the apex was low. No differences were observed at 6, 12, 24, 48, 72 hours and 5 days post obturation. This means that resin-based and bioceramic root canal sealers act the same in incidence and postoperative pain severity.

**Keywords:** Postoperative Pain; Sealers; Bioceramic Sealers; Endosequence BC Sealer; Ah-Plus Sealer; Resin-Based Sealer

## Abbreviation

AAP: Asymptomatic Apical Periodontitis; RCT: Root Canal Treatment; NaOCl: Sodium Hypochlorite; ROS: Reactive Oxygen Species

## Introduction

Studies have shown that endodontic postoperative pain between 3 to 58%. Pain may occur in periodontal tissues after me-

chanical, chemical and microbial injuries. There are various parameters in treatment that can cause postoperative pain. one of these parameters is including working length. Also, the number of visits, selection of instruments and the selection of root canal sealers are other related parameters [1,2].

Sealers placed in the root canals and interact with the periodontal tissues through the apical perforation, lateral canals or leaching can affect the periodontium's healing process. As a result, postoperative pain is caused by local inflammation of the root canal [2]. The intensity of inflammatory reactions depends on a number of different factors, including the composition of the sealers [1].

Bioceramic materials can help endodontic treatment by releasing biologically active substances and promoting odontoblasts' differentiation. *In vitro* studies have shown that bioceramic materials were less cytotoxic than resin based materials. Other studies have also shown that resin based have stronger bonding capacity and higher radiopacity than bioceramic materials [2].

The evolution of newer techniques, instruments, materials and better understanding of canal anatomy has changes the face of endodontic completely. One concept that the emerged is the single-visit root canal therapy. Single visit root canal treatment (RCT) has become a common practice and offers several advantages, including a reduced flare-up rate, decreased number of operative procedures and no risk of inter-appointment leakage through temporary restorations [3].

The major consideration regarding one-appointment endodontics has been the concern about postoperative pain. Various studies have evaluated the post-endodontic pain difference between single and multiple visit RCT, but most studies have ruled out any significance difference in postoperative pain [3].

## Materials and Methods

### Materials

Endosequence BC sealer (Bressler USA) sealer and AH-Plus (Dentsply DeTrey, Germany) sealer.

## Methods

### Trial design

The trial design of the study was randomized, parallel, double blinded clinical design. Randomized clinical trials are the gold standard of clinical research applied to new medical interventions.

### Study setting

Recruitment of the study participants was done from the outpatient clinic of the Endodontic Department, Faculty of Dentistry, Cairo University.

### Sample size

Sample size was calculated using the (PS software). As regarding the primary outcome (post-operative pain) we found that 34 patients per group was appropriate sample size for the study with total sample size 68 patients (2 groups) the power is 80% and α error probability =0.05.

### Ethical consideration

The protocol of the trial was approved by the Ethics committee, Faculty of Dentistry, Cairo University. Each patient received full explanation of the treatment procedures and the associated possible discomforts. The patients was asked to follow general instructions and to sign a printed informed consent (appendix V) explaining the aim of the study and obligating the patients to fill the visual analogue scale chart recording the level of pain at 6, 12, 24, 48, 72 hours and 5 days after root canal obturation and return it at the specific time. The patients were also contacted by telephone at the specified times to provide their pain score according to the visual analogue scale.

### Participants

### Eligibility criteria for participants

Inclusion criteria

- Age between 18 - 65 years old
- Males of Females
- Multirooted teeth with
- No pain on percussion
- Normal periapical radiographic appearance.

Exclusion criteria

- Patients having significant systemic disorders
- Patients taking anti-inflammatory or antibiotics
- Teeth that have
  - Association with swelling or fistulous tract
  - Acute or periapical abscess
  - Greater than grade I mobility

- No possible restorability
- Previous endodontic treatment
- Incomplete formed apex or calcified canals.

### Randomization

In order to assign participants by chance and not choice, to either intervention or comparator groups, randomization was done. The comparator group was the group of participants who had undergone root canal obturation using AH-Plus sealer, while the intervention group was the group of participants who had undergone root canal obturation using Endosequence BC sealer.

### Random sequence generation

A computerized random sequence had been generated used computer software (http://www. random. org/). The sequence generation had been done for the patients' numbers which results in a sequence of random numbers divided in two columns, where one column assigned for the intervention groups and one for the controlled group. The patients had been allocated into either of the two groups with allocation ratio 1:1.

### Allocation concealment

This was the procedure of protecting the randomization process so that the treatment have been allocated was not known until assignment irreversibly occurs. For the allocation concealment mechanism, individually placed numbers in an opaque sealed envelope. Each participant was to picked an envelope before treatment.

### Implementation

Allocation sequence generation: the co-supervisor who would assign the participants to either groups and had been the only one to knew whether a or b represents the intervention or the control group.

### Endodontic procedure

After diagnosing the case as asymptomatic apical periodontitis and confirming that the patient conforms to all eligibility criteria, the patient was enrolled in the study.

The tooth was anesthetized using inferior alveolar nerve block technique by local anesthesia of 1.8 ml of 2% Mepivacaine HCl with 1: 100,000 epinephrine (Carpule Mepecaine-L, Alexandria Company for Pharmaceuticals and Chemical Industries, Egypt.). The access cavity preparation was performed using round carbide bur size 3 (DENTSPLY, Tulsa Dental, DENTSPLY Maillefer, TN.) and Endo-z bur (Endo-Z™ Bur, DENTSPLY, Tulsa Dental, DENTSPLY Maillefer, TN.).

The tooth was then properly isolated with a rubber dam. The canals were explored for patency with #10 or #15 K-type hand files (K-files, MANI, INC., Industrial Park, Utsunomiya, Tochigi, Japan.) according to the initial diameter of the foramen and its canal curvature using a watch-winding motion.

The working length (WL) was established by introducing a #10 K-file till it reaches 0.5 mm from the apical foramen as determined by using an apex locator (Root ZX mini apex locator, J Morita Corp, Kyoto, Japan), which was measured with the aid of an endodontic ruler. The WL was confirmed radiographically.

All instruments were driven by an electric gear reduction torque-controlled motor (X- Smart plus, Dentsply-Maillefer, Ballaigues, Switzerland.). And the system used was M3 pro gold rotary files. The instrumentation sequence used during the treatments followed the procedure recommended by the respective manufacturer. The first file (#17/08) was used to prepare the coronal two third then the apical preparation was done using file of sizes (#20/04, #25/04 and #30/04). In-and-out motions had been applied with stroke lengths not exceeding 3 mm in the cervical, middle, and apical thirds until attaining the established WL. The first file had been used with a continuous rotary motion at a speed of 300 rpm and torque of 3. 0 Ncm. The following files had been used with a speed of 350 rpm and torque of 1.5 ncm.

Irrigation with 5.25% sodium hypochlorite (NaOCl) was performed during the procedure using a 24-G needle during access and a 30-G side-vented closed-end needle when reaching the WL after each file insertion.

Master cones of gutta-percha (Gutta Percha Points, Dentsply Tulsa Dental Specialties. Dentsply VDW, Munchen, Germany). were selected corresponding to the same size and taper of the master apical files.

A radiograph was taken to ensure proper length. the coronal chamber was flushed with 1 mL 2.5% NaOCl, then followed by nor-

mal saline as the final irrigation, sufficient dryness was achieved using paper points (Paper points, META BIOMED CO., LTD, Korea).

For the obturation step patient was divided into two groups: intervention groups Endosequence BC (Bressler USA) sealer was used, comparator group AH-Plus (Dentsply DeTrey, Konstanz, Germany) sealer was used, The obturation technique used was warm vertical compaction technique.

The treatment was concluded with sealing the access cavity with a temporary restoration (MD-TEMP, META BIOMED CO., LTD, Korea.). The patient was instructed to return to complete the treatment procedures until placing a full-coverage restoration.

### Outcomes

The primary outcome was to measure the intensity of postoperative pain using a visual analog scale (VAS) after 6, 12 and 24 hours post obturation treatment. and the secondary outcomes was to measure the intensity of postoperative pain using a visual analog scale (VAS) after 48, 72 hours and 5 days post obturation treatment.

The visual analogue scale consists of a 100-mm long line, the following cut points on the pain was recommended as, No pain (0 - 4 mm), Mild pain (5 - 44 mm), Moderate pain (45 - 74 mm) and Severe pain (75 - 100 mm). The scores were determined by measuring in millimeters the distance on the 10-cm line between the " no pain " anchor on the left hand end of the line to the patent's mark.

The scale was explained visually and verbally to facilitate its use by the participants. The participants were reminded to fill the VAS at the designated times through a phone call to ensure their adherence.

### Statistical analysis

Statistical analysis was performed with IBM® SPSS® Statistics Version 25. Numerical data were presented as mean, standard deviation (SD). Data were explored for normality by checking the data distribution using Kolmogorov-Smirnov and Shapiro-Wilk tests. Non Parametric data were analyzed using Mann whiteny test for comparisons between two groups and Friedman test on comparing multiple duration in the same group. The significance level was set at $P \leq 0.05$ within all tests.

## Results and Discussion

### Results

Post-operative pain, represented in figure 1.

After 6 hours 24 (70.6%) patients in Endosequence BC, 23 patients (67.6%) in AH Plus group had no pain. 5(14.7%) patients in Endosequence BC, 6 patients (17.6%) in AH Plus group had mild pain. While 3 patients (8.8%) in both groups complained from moderate pain. 2 patients (5.9%) of studied groups from severe pain, no statistically significant difference found between groups ($p = 0.9$).

After 12 hours 28 patients (82.4%)in Endosequence BC, 24 patients (70.6%) in AH Plus group had no pain. 4 patients (11.8%) in Endosequence BC, 6 patients (17.6%) in AH Plus group had mild pain. While 2 patients (5.9%) in both groups complained from moderate pain. No patients (0%) in Endosequence BC had severe pain, while 2 patients (5.9%) of AH Plus complained from severe pain, no statistically significant difference found between groups ($p = 0.4$).

After 24 hours 32 patients (94.10%) in Endosequence BC, 30 patients (88.2%) in AH Plus group had no pain. 2 patients (5.9%) in both groups complained from mild pain. no patients (0%) in Endosequence BC had moderate and severe pain, while 2 patients (5.9%) of AH Plus complained from moderate pain and no patients complaining from severe pain, no statistically significant difference found between groups ($p = 0.3$).

After 48 hours 34 patients (100%) in Endosequence BC, 32 patients (94.1%) in AH Plus group had no pain. 2 patients (5.9%) in AH Plus group complained from mild pain. no statistically significant difference found between groups ($p = 0.1$).

After 72 hours All patient (100%) in the studied groups showed no pain.

After 5 days All patient (100%) in the studied groups showed no pain.

*; significant ($p < 0.05$) ns; non-significant ($p > 0.05$).

Table 1 incidence of post-operative pain at different pain categories of the all groups after 6 hrs, 12 hrs, 24 hrs, 48 hrs, 72hrs, and 5 days.

**Figure 1:** Bar chart representing the incidence of pain at different time intervals for each group.

Intensity of postoperative pain between the two groups at different observational periods, represented in table (1) and figure (2).

After 6 hours, the intensity of pain was 13.24 ± 23.83 in the Endosequence BC group, and 13.53 ± 24.48 in AH Plus group with no statistically significant difference between the tested groups (P = 0.845).

After 12 hours, the intensity of pain was 5.88 ± 15.2 in the Endosequence BC group, and 11.18 ± 21.99 in AH Plus group with no statistically significant difference between the tested groups (P = 0.247).

After 24 hours, the intensity of pain was 0.59 ± 2.39 in the Endosequence BC group, and 5.29 ± 17.1in AH Plus group with no statistically significant difference between the tested groups (P = 0.343).

After 48 hours, the intensity of pain was 0 ± 0 in the Endosequence BC group, and 1.18 ± 4.78 in AH Plus group with no statistically significant difference between the tested groups (P = 0.154).

After 72 hours, the intensity of pain was 0 ± 0 in both groups with no statistically significant difference between the tested groups (P = 1).

After 5 days, the intensity of pain was 0 ± 0 in both groups with no statistically significant difference between the tested groups (P = 1).

| | Endosequence BC | | AH Plus | | |
|---|---|---|---|---|---|
| | **Mean ± SD** | **Median (range)** | **Mean ± SD** | **Median (range)** | **P-value** |
| After 6hrs | 13.24 ± 23.83 | 0(0-80) | 13.53 ± 24.48 | 0(0-80) | 0.845 |
| After 12hrs | 5.88 ± 15.2 | 0(0-60) | 11.18 ± 21.99 | 0(0-60) | 0.247 |
| After 24hrs | 0.59 ± 2.39 | 0(0-10) | 5.29 ± 17.1 | 0(0-10) | 0.343 |
| After 48hrs | 0 ± 0 | 0(0-0) | 1.18 ± 4.78 | 0(0-0) | 0.154 |
| After 72hrs | 0 ± 0 | 0(0-0) | 0 ± 0 | 0(0-0) | 1 |
| After 5 days | 0 ± 0 | 0(0-0) | 0 ± 0 | 0(0-0) | 1 |
| p-value | <0.001* | | <0.001* | | |

**Table 1:** Intensity of post-operative pain of the tested groups after 6 hrs., 12 hrs., 24 hrs., 48 hrs, 72 hrs and 5 days.

*; significant (p < 0.05) ns; non-significant (p > 0.05).

**Figure 2:** Bar chart of the intensity of post-operative pain at different time intervals for each group.

## Change with time in post-operative spontaneous mean pain score within each group

In Endosequence BC group, shown in table 2 and figure 3.

The mean value of spontaneous pain score decreased from 13.24 ± 23.83 after 6 hours, followed by successive decrease in its intensity to be 5.88 ± 15.2 after 12 hours, 0.59 ± 2.39 after 24 hours, finally it reached (0.00 ± 0.00) after 48hrs, 72hrs and 5 days.

Friedman test showed a statistically significant decrease in the intensity of pain at different time intervals ($p < 0.001$).

| | Endosequence BC | |
|---|---|---|
| | **Mean** | **SD** |
| After 6hrs | 13.24 | 23.83 |
| After 12hrs | 5.88 | 15.2 |
| After 24hrs | 0.59 | 2.39 |
| After 48hrs | 0 | 0 |
| After 72hrs | 0 | 0 |
| After 5 days | 0 | 0 |
| p-value | <0.001* | |

**Table 2:** Mean intensity of post-operative spontaneous pain at different time intervals for Endosequence BC group.

* denotes significant difference ($p \leq 0.05$).

**Figure 3:** Bar chart of mean intensity of post-operative pain at different time intervals for Endosequence BC group.

In the AH Plus group, shown in table 3, Figure 4.

The mean value of spontaneous pain score decreased from 13.53 ± 24.48 after 6 hours, followed by successive decrease in its intensity to be 11.18 ± 21.99 after 12 hours, 5.29 ± 17.1 after 24 hours, to 1.18 ± 4.78, finally it reached 0.00 ± 0.00 after 72hrs and 5 days. Friedman test showed a statistically significant decrease in the intensity of pain at different time intervals ($p < 0.001$).

## Discussion

The experience of post endodontic pain is one of the most common patients' complaints after root canal treatment. This symptom could affect the life quality and routine daily functions of patients. Therefore, it is important for clinicians to manage the patients' discomfort after treatment as well as pain management during RCT [4].

| | AH Plus | |
|---|---|---|
| | **Mean** | **SD** |
| After 6hrs | 13.53 | 24.48 |
| After 12hrs | 11.18 | 21.99 |
| After 24hrs | 5.29 | 17.1 |
| After 48hrs | 1.18 | 4.78 |
| After 72hrs | 0 | 0 |
| After 5 days | 0 | 0 |
| p-value | <0.001* | |

**Table 3:** Mean intensity of post-operative spontaneous pain at different time intervals for AH Plus group.

* denotes significant difference ($p \leq 0.05$).

**Figure 4:** Bar chart of mean intensity of post-operative pain at different time intervals for AH Plus group.

In literature, reported frequencies of post-endodontic pain range from 1.5 to 53% [5,6]. The success and failure of endodontic treatment is determined by long-term results and not the presence or absence of short-term postoperative pain [5].

Postoperative pain in endodontics reflects activation of the local inflammatory response in the periapical tissues [7], which is known to be associated with the release of biochemical mediators such as reactive oxygen species (ROS) [8]. Oxidative stress and, more specifically. ROS have been shown to be linked with inflammatory pain *in vivo* [9,10]. *In vivo* studies have reported that reac-

tive oxygen species can be directly associated with inflammatory pain [10]. If human pulp cells were treated *in vitro* with the root canal sealers, reactive oxygen species would increase from 4 to 7 times [11,12].

The observed cytotoxicity of the sealers implied that their contact with the periapical tissues could provoke postoperative pain. Moreover, the occurrence of the clinical symptoms was associated with the composition of the sealer [13].

Resin based sealers was slightly cytotoxic [14] and released toxic monomers, such as bisphenol A diglicidyl ether [15]. The bioceramic sealer exhibited a cytotoxic effect as well although it was significantly lower compared with resin based sealers. Postoperative pain is triggered when the sealers' cytotoxicity implied contact with the periapical tissue in gross overfilling cases [16,17].

One of the main concerns about studying pain is the subjectivity of the evaluation. Each person's pain threshold is unique, and heavily dependent on his cultural, individual, and economic background. Several endodontic postoperative pain studies have used the Visual Analogue Scale (VAS) as an instrument to evaluate pain [18-20]. The VAS is easier to use a numeric rating scale than to rate pain more broadly using categories such as "mild," "moderate," and "severe" by patients [18].

The numbers of sessions for the treatment of each tooth are one of the factors that should be considered. Various studies evaluated the effects of single and multiple visit treatments on the experience of post endodontic by patients [21]. However, the results of these studies were not comparable due to the inconsistency in studies such as demographic differences among studied individuals, individuals' pain threshold in evaluated teeth, sample size, and different pain measurement scales [5,21,22].

It is well-known that pain perception is highly subjective and influenced by many factors, and the most effective method of pain evaluation is self-evaluation. Thus, results were based on the patient's report of post obturation pain. An accurate classification of pain and its measurement is essential and makes the precise definition of different discomfort categories and detailed description of pain difficult [3].

It is difficult to attribute the pain incidence to any specific factor in clinical research because endodontic treatment comprises a complex of procedures including chemo mechanical debridement and obturation. Even though the retreatment of teeth with AAP was shown to cause fewer symptoms than in vital noninfected cases [23].

The present study was designed as randomized clinical trial, In this proposed study, both the participant and assessor will be blinded. This is achieved where the outcome assessor will not be informed of the group in which the participant is enrolled for subjective outcomes. The treatment groups will remain anonymous at the end of the study during assessment by the statistician.

Randomization makes the groups of the study as similar as possible and allows each patient to take the same chance of being assigned to either the intervention or the comparator group without any choice of the operator [24,25].

RCTs usually try to measure and compare different outcomes that are present or absent after the participants receive the interventions. RCTs are also considered as comparative studies as they are used in obtaining information about adverse drug reactions and/or adverse effects of treatments and efficacy or effectiveness of new interventions in healthcare services and health technologies like medicine, nursing, pharmaceuticals, medical devices or surgery [26].

This study was designed to is to compare the effect of AH-Plus sealer and Endosequence BC sealer on the intensity of postoperative pain in patients with asymptomatic apical periodontitis (AAP) treated in single visit.

Only multirooted teeth were selected in the present study to avoid any possible confounding factors on the outcome due to variations in tooth type. The canals were shaped with rotary instruments that are known to cause less postoperative pain in patients [27]. Postoperative pain was previously shown to be significantly lower in teeth with periapical radiolucency [28]. Therefore, for the present study only patients diagnosed with AAP were selected. Single visit endodontic therapy was used in this study to minimize the number of procedures and variations of intracanal medication used. VAS scale is a validated method for measuring postoperative pain in dental research [28,29].

The diagnosis of asymptomatic apical periodontitis is confirmed through: examination including cold pulp testing, heat testing,

electric testing, percussion and palpation evaluation, periodontal probing, mobility assessment, and a periapical radiograph, these cases have no clinical symptoms and usually responds negatively to thermal testing and no pain on percussion or palpation but may have had trauma or deep caries that results in necrotic pulp, only those patients with a diagnosis of asymptomatic apical periodontitis were included in the study.

Patients giving history of analgesic or antibiotic intake 1 week before treatment were excluded from the study to avoid any misinterpretation of the diagnosis or the post-treatment pain scores. A study by Menke., *et al*. (2000) [30] showed that prophylactic ibuprofen administration significantly reduced post-endodontic pain at 4 and 8 hours after initiation of root canal therapy. Mokhtari., *et al*. (2016) [31] stated that ibuprofen pre-medication significantly reduced post-operative pain compared with placebo during treatment and 8 hours post-treatment.

After access cavity preparation, rubber dam isolation was conducted prior to instrumentation of the root canal system to minimize the risk of saliva contamination and ingestion of chemicals or aspiration of instruments. The use of a rubber dam during root canal treatment is considered the standard of care because it enhances patient's safety, a pivotal aspect of healthcare, and enhances the odds of a successful treatment [32].

In the present study, the working length (WL) was determined by Root ZX mini electronic apex locator due to its high accuracy which had been asserted *in vitro* and *in vivo*, then this working length was further confirmed by the radiograph. This greatly confines the instrumentation within the root canal system [33,34] One of the iatrogenic factors causing the postoperative pain and flare-up of the endodontic treatment is incorrectly measured working length of the root canal [35].

It is impossible to localize the conjunction area of cementum and dentine according to radiological Working length evaluation technique, also there might be a distortion of radiological views in addition to the possibility that roots and adjacent structures might cover one another hindering proper working length determination. Therefore it is essential to combine radiological data with the results of an electronic apex locator [34].

For obturation, patients were randomly divided into two treatment groups depending upon sealer used. In intervention group Endosequence BC (Bressler USA) sealer was used, which is composed of Zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, filler and thickening agents [36].

A pre-mixed bioceramic endodontic sealer (Endosequence BC Sealer®, Brasseler USA, Savannah, GA, USA) was recently proposed as an alternative root canal filling material. The main advantages of bioceramic materials for dental application are related to their physicochemical and biological properties [37,38]. This specific material has an alkaline pH, high calcium ions release and suitable radiopacity and flow capacity [38,39] Endosequence BC sealer also exhibits several positive biological characteristics, such as antibacterial activity [40] and biocompatibility [37,41]. However, there are other important biological characteristics that endodontic sealers must exhibit to promote suitable healing of periapical tissues. Thus, the potential cell DNA damage (genotoxicity) of several endodontic sealers has been evaluated [38,42-47].

And in control group AH Plus (Dentsply DeTrey, Konstanz, Germany) sealer was used, which is composed of Epoxy paste: diepoxy, calcium tungstate, zirconium oxide, aerosol and dye. Amine paste: 1-adamantane amine, N'dibenzyl-5 oxanonandiamine-1,9, TCD-diamine, calcium tungstate, zirconium oxide, aerosol and silicone oil [36].

Epoxy-resin sealers are among the products most commonly used in the clinical practice. They exhibit very low shrinkage rates during setting, as well as long-term dimensional stability, and polymerization with null or minimum release of formaldehyde· They are also able to bond to dentin and exert a good sealing ability, in addition they present antimicrobial features. As shown in several studies [48], the epoxy-based sealers currently used in endodontics exhibit a variable degree of cytotoxicity.

A study was conducted by Troiano., *et al.* (2018) [49] to evaluate the cytotoxicity of three epoxy resin-based endodontic sealer, AH Plus, Sicura Seal and Top Seal. Both results related to direct and indirect cell viability tests showed that all groups were significantly more cytotoxic than the negative control group. The cytotoxicity activity after one week of culture showed the absence of direct cytotoxicity, while a medium rate of indirect cytotoxicity. It was concluded that the Analysis of the cytotoxicity of AH Plus, Top Seal and Sicura Seal revealed that all the three epoxy resin- based sealers possess a moderate grade of cytotoxicity on human osteoblast-like cells. A direct cytotoxicity is present in the short term when sealers

come directly in contact with cells, but it tends to strongly decrease after a week. While, cytotoxicity due to the release of exudates is present also after a week of culture. No differences have been found regarding the comparison of the three endodontic root canal sealers analyzed.

For the assessment of Postoperative Pain: The primary study outcome was postoperative pain. Every patient received a visual analog scale (VAS) to record pain intensity at 6, 12, 24 hours, and secondary outcome was to record postoperative pain intensity at 48, 72 hours and 5 days after treatment.

The findings of this study documented no statistically significant in the incidence of post-operative pain in the Endosequence BC sealer compared to AH Plus sealer at all the observational periods (6, 12, 24, 48, 72 hours and 5 days) where P =0.845, P = 0.247, P =0.343, P =0.154, P = 1 and P = 1 respectively. This provided that there are various parameters in treatment that can cause postoperative pain. One of these parameters is including working length (WL). Also, the number of visits, selection of instruments, and the selection of root canal sealers are other related parameters [2].

Despite the thorough control of the potential causative factors of pain, it was still recorded in this study. The highest VAS score was reported at 6 hours after obturation and Friedman test showed a statistically significant decrease in the intensity of pain with time. One could speculate that cytotoxic unpolymerized root canal sealers known to induce ROS formation before material setting and their leaching components could have played a role during the first 24 hours [19].

The results of the present study are in accordance with the results by Graunaite., *et al*. (2018) [19] and Troiano., *et al*. (2018) [49] who compared the effect of resin-based (AH Plus) and bioceramic (Total Fill) root canal sealers on the occurrence and intensity of postoperative pain in patients with asymptomatic apical periodontitis (AAP) and found that the sealers performed similarly in terms of occurrence and intensity of postoperative pain when the other treatment related irritants were minimized.

In addition to Jamali., *et al*. (2021) [2] who conducted a systematic review on the effect of resin and bioceramic root canal sealers on postoperative intensity and pain occurrence and found that resin-based and bioceramic root canal sealers act the same in incidence and postoperative pain severity.

Also Tan., *et al*. (2021) [50] evaluated the incidence of immediate postobturation pain associated with TotalFill BC (FKG Dentaire SA, La Chaux-de-Fonds, Switzerland) and AH Plus sealer (Dentsply Maillefer, Ballaigues, Switzerland) and concluded that there was no significant difference in pain experience between teeth filled using AH Plus or TotalFill BC Sealer 1, 3, and 7 days after obturation. Patient- and treatment-related factors could influence postobturation pain.

However, Gudlavallet., *et al*. (2020) [51] found that when AH Plus was used as root canal sealer, the pain after using AH plus as root canal sealer was relatively much lesser compared to the preoperative status. Thus, inferring that the choice of root canal sealer used has an influence of post-treatment discomfort.

These findings are in contrast to Ates., *et al*. (2019) [18] who compared the postoperative pain after root canal treatment using a carrier-based obturation system with AH Plus or iRoot SP sealers and found that iRoot SP sealer was associated with less analgesic intake compared to AH Plus sealer.

In addition to Khandelwal., *et al*. (2021) [52] who evaluated and compared postoperative pain and periapical healing after root canal treatment using different base endodontic sealers Tubli-Seal, AH Plus and BioRoot RCS. And found that BioRoot RCS showed less postoperative pain compared to AH Plus and Tubli-Seal. BioRoot RCS showed better periapical healing compared to AH Plus and Tubliseal at 3- and 6-months interval respectively.

In conclusion, post endodontic pain in the teeth diagnosed with asymptomatic apical periodontitis (AAP) and obturated with resin based or bioceramic root canal sealers without extrusion beyond the apex was low. No differences were observed at 6, 12, 24, 48, 72 hours and 5 days post obturation. This means that resin-based and bioceramic root canal sealers act the same in incidence and postoperative pain severity.

## Conclusion

Within the limitations of this study, it could be concluded that, post endodontic pain in the teeth diagnosed with asymptomatic apical periodontitis (AAP) and obturated with resin based or bioceramic root canal sealers without extrusion beyond the apex was low. No differences were observed at 6, 12, 24, 48, 72 hours and 5 days post obturation. This means that resin-based and bioceramic root canal sealers act the same in incidence and postoperative pain severity.

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## Conflict of Interest

I declare that this thesis has been composed solely by myself and there is no conflict of interest.

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